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## EUROPEAN PATENT APPLICATION

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### (54) Composite wound dressing.

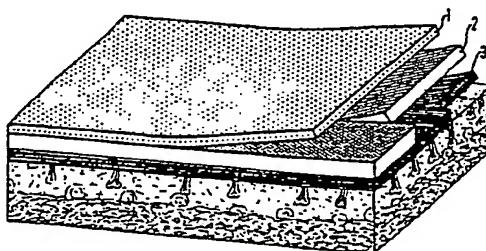
(57) The multilayered composite wound dressing comprises of a semipermeable membrane, a permeable supporting and reinforcing layer, and a non-stick, self-sealing biodegradable tissue interface. The semipermeable membrane may be a synthetic collagen, an alginate or a biocompatible polymer and it controls the rate of water vapour transmission from the wound surface. The permeable supporting and reinforcing layer provides mechanical strength and is usually a textile fabric which may also be made electrically conductive by coating it with a carbon-doped silicon or natural rubber or depositing metal on the fabric. Alternatively, an activated carbon cloth fabric can also be used. The biodegradable tissue interface may be synthetic collagen, sodium-calcium alginate or collagen-alginate complex, and it provides non-stick haemostatic sealing and aids the wound repair processes. For topical medication, growth promoting, antibacterial, anti-allergic and therapeutic agents may also be incorporated.

Any combination of each of the materials suitable for a particular layer can be used for a specific application.

The conductive supporting and reinforcing layer can be used to provide electrical charge transfer and stimulation of the wound using external fields which has been shown to enhance the wound healing process, produce post-operative pain relief and bacterial-inhibition. The composite wound dressing has application inter alia in treating general surgical

wounds, burns, bedsores, infected ulcers, donor sites for skin grafts or alternatively can be used for electrode dressing in transcutaneous and functional stimulation.

FIG. 1.



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Preferably said permeable layer is polyester, polyethylene or cotton fabric coated with carbon doped silicon or natural rubber. Alternatively, said fabrics are plated or deposited with metals such as silver, zinc, gold, platinum and  
5 the like.

Alternatively, said permeable layer is charcoal cloth fabric consisting of substantially 100% activated carbon, said cloth fabric being produced by carbonising and activating (700 - 1200)<sup>o</sup>C a woven viscose rayon fabric.

10 Preferably also, said biodegradable interface is a synthetic collagen produced from animal sources such as calf skin and intestines. Alternatively, the biodegradable tissue interface is a Na-Ca alginate produced from seaweeds. Preferably also, the said biodegradable tissue interface is a collagen-alginate complex with ratio of (0.1 - 30) and it is prepared as porous  
15 structure.

20 Preferably also, the semipermeable membrane is a synthetic collagen. Alternatively, the semipermeable membrane may be an alginate or a biocompatible polymer such as polyurethane, polypropylene, silicon rubber etc.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic diagram of a composite wound  
25 dressing in accordance with the present invention, and

Fig. 2 is an alternative diagram of another composite wound dressing in accordance with the present invention;

Fig. 3 is a schematic diagram of a composite wound dressing for use on burns in accordance with the present invention;

30 Fig. 4 is a schematic diagram of a composite wound dressing for use of a general wound dressing without electrical stimulation, and

Fig. 5 is a schematic diagram of a composite wound dressing for use in providing transcutaneous pain relief and for

to Fig. 1, however, the carbon-doped silicon rubber is the electrically conductive reinforcing permeable layer.

An external electro-motive-force or magnetic field (both denoted as EMF) can influence both normal neurovascular processes and tissue repair mechanisms. The doping should not give preferably electrical resistance greater than 600 ohms/square unit since this necessitates providing a higher voltage to maintain a current within the tissue sufficient to provide EMF assisted wound healing. A typical example for current density is (1-10) A/cm<sup>2</sup>.

With respect to neurovascular control, an externally applied EMF will induce localised vasoconstriction to re-establish the balanced osmotic feedback between the blood vessels and the neighbouring tissue. Thus the widened and damaged capillary bed, due to trauma induced histamine stimulation, will contract due to the applied EMF.

The protein concentration in the blood vessels will be maintained at a high level and consequently water will be drawn back into these vessels by osmosis. This re-establishment of osmotic feedback prevents the accumulation of both water and proteins in the surrounding tissue, thus reducing local pain and inflammation due to the fluid pressure on the sensory nerve endings.

Additionally, an externally applied EMF can accelerate the tissue regeneration aspect of healing by restoring order to the basic biological processes of all division and synthesis which give rise to the large numbers of phagocytes necessary for epithelialisation to proceed. Here the postulated mechanism is one of stabilisation of the normal cellular activities followed by an early acceleration of the cell synthesis required for tissue reconstruction.

Results showed that wounds treated with such a dressing and having external EMF's applied healed better and quicker than unstimulated wounds with minimum scar formation.

With regard to the wound dressing shown in Fig. 3 a polyurethane polymer 7 is the semipermeable membrane, the

It is also possible to omit the semipermeable membrane for situations like transcutaneous stimulation for pain relief.

In addition topical growth promoting, antibacterial or antiallergic agents such as silver sulphadiazene, zinc and other substances may be incorporated into the dressing, preferably into the collagen, alginate or collagen-alginate of the biodegradable tissue interface.

The advantages of the composite wound dressing according to the present invention include; control of the rate of water vapour transmission from the wound thereby presenting local dehydration, all processes in the wound healing phase are enhanced, e.g. inflammation is reduced, epithelialisation and collagen synthesis is increased, its layered structure gives it flexibility and mechanical strength and facilitates easy handling, the electrical conductivity of the supporting layer can be used to facilitate post-operative pain relief, and the dressing is self-sealing non-tissue adhesive, simply peeling off when required, when the dressing is used in the EMF assisted mode, the collagen synthesis phase of the wound healing is greatly enhanced thereby increasing the strength of the wound in the long term, and reduced scar formation and improved clinical appearance are an advantage of using this composite wound dressing.

produced as a semipermeable film or an opened foamed structure.

10. A wound dressing as claimed in any preceding claims wherein the biodegradable tissue interface is treated (with methylglyoxal or alike) to increase electron spin density and electrical conductivity and dielectric dispersion.
11. A wound dressing as claimed in any preceding claim wherein the semipermeable membrane is a synthetic collagen.
12. A wound dressing as claimed in any one of claims 1-8 where the semipermeable membrane is an alginate or biocompatible polymer.
13. A wound dressing as claimed in any of the claims of the (1-11) where any one of the composite layer material is used as a temporary wound cover.
14. A composite wound dressing comprising in a layered arrangement, a semipermeable membrane and a biodegradable tissue interface.
15. A composite wound dressing comprising in a layered arrangement, a reinforcing and supporting permeable layer and biodegradable tissue interface.
16. A composite wound dressing comprising in a layered arrangement, a semipermeable membrane and an electrically conductive reinforcing and supporting permeable layer.
17. A permeable electrically conductive dressing as hereinbefore described with reference to Fig. (1, 2, 3, 4, 5) of the drawings.
18. A wound dressing substantially as hereinbefore described with reference to Fig. 1 or Fig. 2 or Fig. 3 or Fig. 4 or Fig. 5 of the drawings with or without incorporating growth promoting therapeutic antibacterial or anti-allergic agents for controlled topical therapy.

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FIG. 2.

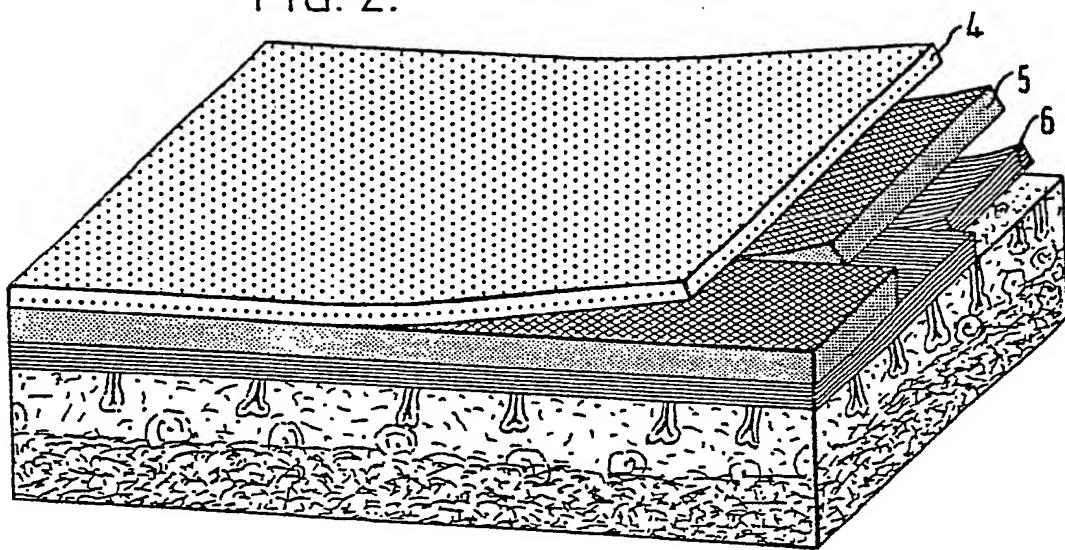
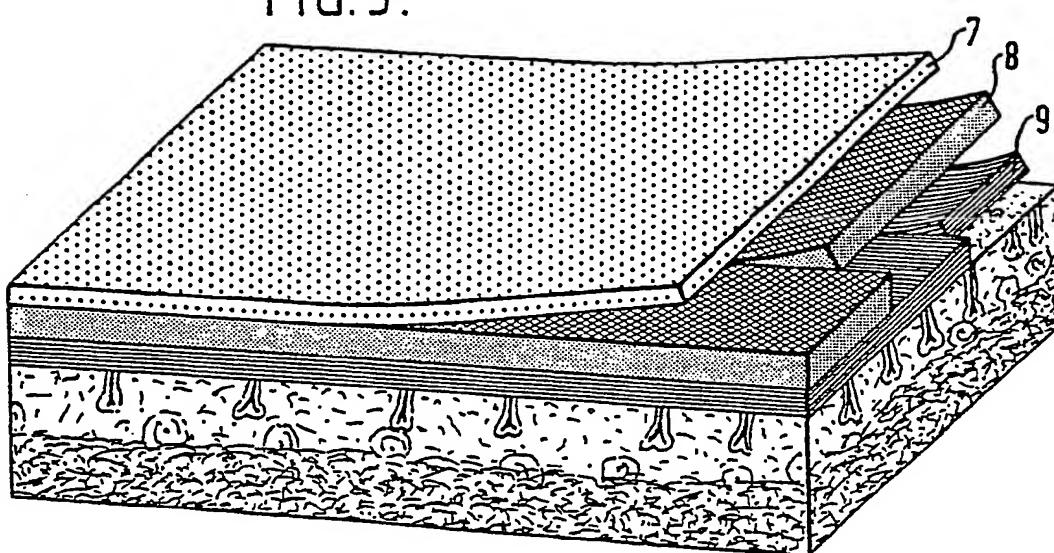


FIG. 3.



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(88) Date of deferred publication of search report: 24.10.84

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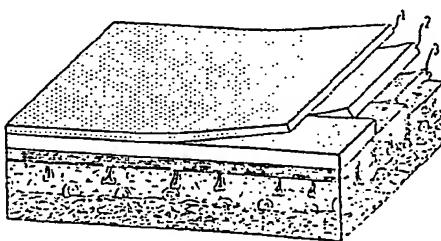
(57) The multilayered composite wound dressing comprises of a semipermeable membrane (1), a permeable supporting and reinforcing layer (2), and a non-stick, self-sealing biodegradable tissue interface (3). The semipermeable membrane (1) may be a synthetic collagen, an alginate or a biocompatible polymer and it controls the rate of water vapour transmission from the wound surface. The permeable supporting and reinforcing layer (2) provides mechanical strength and is usually a textile fabric which may also be made electrically conductive by coating it with a carbon-doped silicon or natural rubber or depositing metal on the fabric. Alternatively, an activated carbon cloth fabric can also be used. The biodegradable tissue interface (3) may be synthetic collagen, sodium-calcium alginate or collagen-alginate complex, and it provides non-stick haemostatic sealing and aids the wound repair processes. For topical medication, growth promoting, antibacterial, anti-allergic and therapeutic agents may also be incorporated.

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FIG. 1.



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### CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claims:
- No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

### X LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 1-6, 14, 15, 16
2. Claims 7-10: biodegradable layer
3. Claims 11-12: semi-permeable layer.

- All further search fees have been paid within the fixed time limit. The present European search report has been drawn up to all claims.
- Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid.  
namely claims:
- None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims.  
namely claims: 1-6, 14, 15, 16